

*Youngsters in protective goggles concoct mixtures of solids, liquids and gases, learning how to identify properties of chemical substances at a summer day camp offered by the Lawrence Hall of Science at the University of California, Berkeley.*

# EQUALS

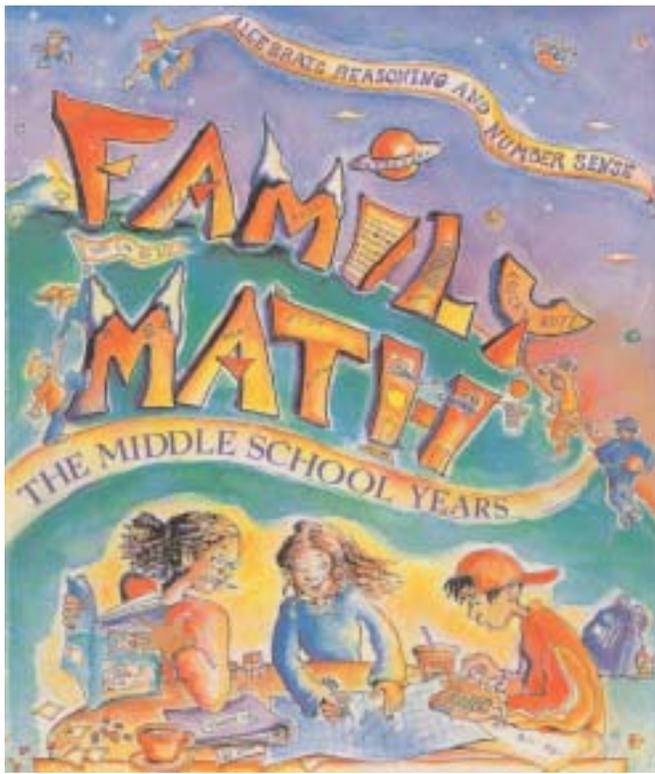
## Equity for All in Education

By LEA TERHUNE

Teachers and students agree, mathematics is not the easiest subject to teach or to learn. But conventional wisdom is turned on its head when innovative, hands-on methods are used. The EQUALS program at the University of California, Berkeley, shows the way.



As kids return to math classes in America in September, the lucky ones may be getting a pleasant surprise. If their teachers attended EQUALS workshops during summer break and took the methods to heart, students will be treated to an entirely new, relevant view of a subject that too often causes tears of frustration. Math can be fun, it can be hands-on experiential, and it can involve the whole family. Mathematics can be grasped by any student regardless of



LEA TERHUNE

The use of objects, space and movement helps students visualize and understand mathematics and science.

*Above: Jose Franco, director of the EQUALS program at the Lawrence Hall of Science, is enthusiastic about multilingual programs that will eventually allow more people to utilize the learning tools.*

gender, race or social status. Eliminate the achievement gap. That is the EQUALS approach in a nutshell.

EQUALS is a non-profit learning program associated with the Lawrence Hall of Science at the University of California, Berkeley. It was born when Berkeley graduate students and professors in the late 1960s observed the paucity of women in math and science graduate programs. Research revealed that girls, from a young age, are conditioned away from mathematical thinking. Parents and teachers unconsciously and even consciously discourage girls from pursuing math studies. As the EQUALS program evolved, it became clear that students from ethnic minorities and lower socio-economic groups had similar difficulties with math and sciences. The founders of the program committed themselves to finding ways to make the subjects more accessible to such students. Since then, innovative curricula and materials and teacher, parent and student training developed by EQUALS have made math comprehensible to more young students, from kindergarten through high school.

Jose Franco has been EQUALS director for 14 years. He did his time in the trenches, teaching in grade school bilingual

*Family Math, a component of the EQUALS program, brings parents together with children in math workshops. Parents are given tools, such as these cartoon-illustrated booklets, to help their kids at home, increasing the likelihood of success.*

programs before he was exposed to EQUALS and eventually started running workshops himself. "I was really impressed by what the EQUALS staff were doing, what message they were conveying to the teachers taking the workshop. And I got really excited about teaching mathematics." The school in Colorado where he began teaching was very traditional. "Everyone used a basic text. Everyone had to be on the same page every day. There were no hands-on experiences, especially in mathematics." He adds, "EQUALS opened up my world when it came to how students should learn math."

What's so different? Instead of demanding rote recitals of multiplication tables, a teacher who is an EQUALS convert may distribute circular pieces of



*A boy rides an earthquake simulator (left) in "The Forces that Shape the Bay" exhibit and adults and kids perfect a sandcastle (right), learning about the effects of water on soil in a summer fun day at the Lawrence Hall of Science.*

PEG SKORPENSKI, courtesy Lawrence Hall of Science

Photographs courtesy Lawrence Hall of Science  
Illustrations by Ann Humphrey Williams, courtesy  
EQUALS/Family Math

## The Lawrence Hall of Science

# A Door to Wonders

By LEA TERHUNE



The Lawrence Hall of Science sits high above the University of California, Berkeley, main campus and enjoys a 180-degree view of the San Francisco Bay. The botanical gardens are next door. Surrounded by nature's wonders, it is an appropriate site for an institution dedicated to inspiring young people to explore mathematics and science.

A memorial to Berkeley's first Nobel laureate, Ernest O. Lawrence, it was opened in 1968 and soon became a national and international focal point of new learning.

What better way for a six-year-old to become acquainted with the double helix than by climbing on its colorful replica in the plaza? Or maybe she'd prefer to crawl over the back of Pheena, the whale, represented in actual whale-like proportions. Inside the hall, interactive exhibits invite children and adults to explore the laws of physics, chemistry and biology and have fun doing it. The planetarium is among the world's best.

Those interested in geology can visit "The Forces that Shape the Bay" exhibit outside. They can feel the earth move and examine faults and types of earth layers to understand how earthquakes happen. Alongside are California's rocks, minerals and drought-resistant plants. Kids can play in the stream table or learn about the Sierra Nevada Mountains watershed.

They can build skyscrapers or play colorful floor games.

Budding naturalists may prefer the basement biology lab, which houses more than 100 animals with information about their habitats and behaviors and how they adapt to the environment. The boy who always wanted to have a tarantula walk on his arm can have his wish granted here.

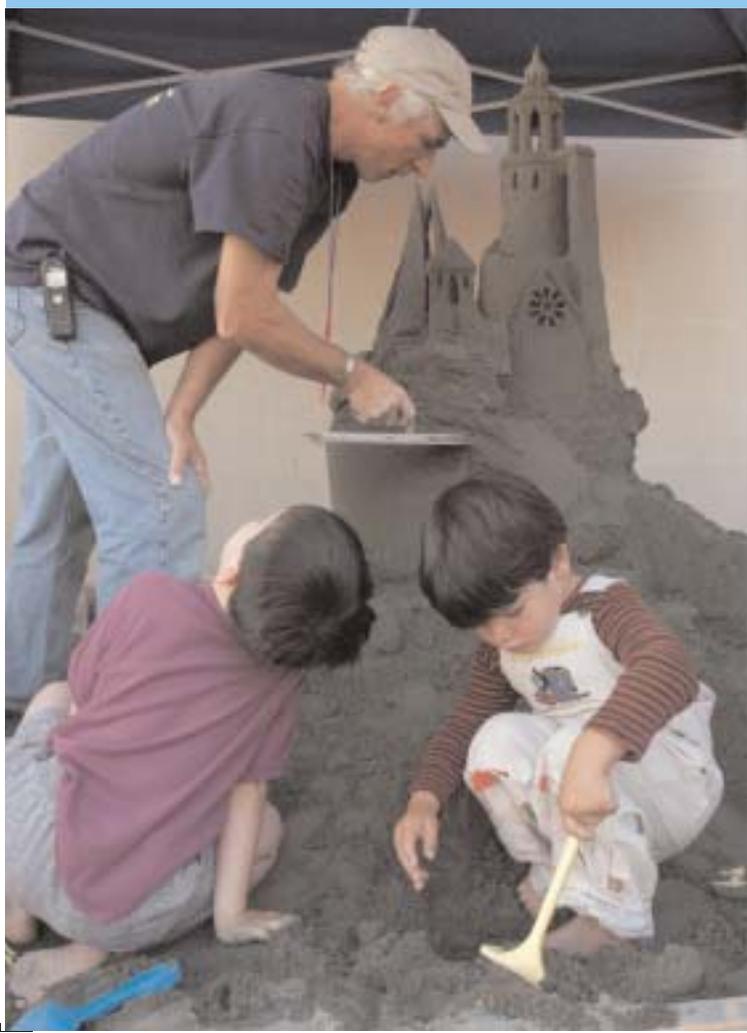
Besides the permanent and periodically changing exhibits, the Hall of Science actively teaches on site and takes its programs to schools. Barbara Adono, associate director for public programs, says there are also teacher leadership programs, and curriculum development projects. The math program EQUALS functions autonomously under the Lawrence umbrella. Adono says, "There's a lot of cross-fertilization and opportunities that would not exist unless the other things were there." It is a dynamic, endlessly creative situation. "It's great to be working with somebody who is working intensely in the schools on a curriculum project and think about turning that into an exhibit or a public program." The research and development is used to tell about the educational programs created for the public and for schools. "It's a lively place," she says.

The schedule is full of options. Summer camps according to age and grade are offered, as are classes during the school year. And what classes! The Wizard's Lab on Wheels demonstrates principles of electricity, optics, sound, movement and magnetism, including the Van de Graff static electricity generator to make kids' hair stand on end. In Crime Lab Chemistry, kids analyze ink to discover who wrote the naughty note. There are classes on Pond Organisms and Animal Behavior, but also Breakfast Cereal Analysis. Computer classes are offered for adults.

Besides the EQUALS and Family Math curricula and publications, there are several other programs that support educational development. The Full Option Science System is an inquiry-based science program for kindergarten through eighth grade. It develops curricula according to advances in understanding how children think and learn. Great Explorations in Math and Science provides materials for preschool through eighth grade students and teachers. Hands-On Universe makes images from professional telescopes and image-processing software available for classroom use, to help teach data interpretation, measurement, critical thinking and other skills. Marine Activities, Resources & Education integrates literacy and science with focus on exploration of the ocean, for kindergarten through eighth grade. Science Education for Public Understanding provides hands-on tools to explore science concepts through personal and societal issues. Instructor-focused programs bring teachers together with scientists to enhance class content with activities in oceanography, chemistry and other sciences.

Some of the projects assess and design the most effective ways to guide students from preschool through graduate school in learning math and science. The goal is to create and widely disseminate model programs for educators and students of science and mathematics. The reach is international, and Lawrence looks for opportunities to bring knowledge to new places. Says Adono: "Our general mission is to improve public understanding of science. And I would add that we are deeply committed to equity. We are deeply committed to scientific rigor." And all that while having a good time.

For more information about programs at Lawrence, log on to [www.lawrencehallofscience.org](http://www.lawrencehallofscience.org). □



PEG SKORPENSKI, courtesy Lawrence Hall of Science

## Brij Kothari Learning Is a Song

By RANJITA BISWAS



Trying to learn Spanish in an American university gave Brij Kothari, an alumnus of the Indian Institute of Management, Ahmedabad, the idea of helping semi-literates back home to improve their reading. It sounded far-fetched, but it turned out to be a simple but effective tool.

Kothari's "lightbulb" moment happened while pursuing a master's degree in communication at Cornell University in New York.

His project frequently took him to Ecuador and he needed to understand Spanish. "So I used to watch a lot of Spanish films with English subtitles. One day, suddenly I thought: Why not Spanish films with Spanish subtitles? It'd be a better way of learning the language. Adding text to the audio, you could actually follow what the native speaker says. Then I exclaimed, 'Why not add subtitles to the popular film song programs in India? This way those who had rudimentary knowledge of the alphabets could learn to read!'"

The casual thought took shape when he returned to teach at the Centre for Educational Innovation at his alma mater in Ahmedabad. Kothari's idea was to use entertainment to augment reading habits among early literates, school dropouts, even adults. "Since a huge number of children and adults watch TV for entertainment, even in rural areas of India, why not use this resource to get an educational benefit out of it?"

This was the beginning of Same Language Subtitling or SLS, in 1996. SLS subtitles film songs, which are popular across India, and builds on people's familiarity with the lyrics. With SLS, they can read the words to their favorite songs.

According to Kothari, SLS "doubles and even triples the rate of reading improvement that children may be achieving through formal education." When his research team visited villages, railway stations and roadside cafés, they found that people who tried it were enthusiastic about the idea.

Kothari approached the Ahmedabad center of Doordarshan to try his idea in "Chitrahaar," a program featuring film song sequences. The government network approved and implemented SLS in 1999. "Chitrahaar" is no longer telecast, but SLS features in the similar "Rangoli" program on Sunday mornings, watched by some 100 million early literates.

SLS is cost-effective, needing only installation of the software. Kothari calculates that it comes to less than one paisa per head per year.

He has big ideas for SLS. "We want to take it internationally. Even in the U.S. there are pockets where people have a reading problem, as statistics show. We can use their popular songs in the same way. In fact, it can be used anywhere in the world. We've formed a group called Planet Read, which will take forward the idea to other countries."

*Brij Kothari uses captions on popular film songs to teach reading in a slum in Ahmedabad.*

The SLS idea won Kothari an award in 2002 at the World Bank's Development Marketplace, a development forum, giving him enough funds to implement the program nationally. It was recognized as the Best Social Invention of 2000 by the U.K.-based Institute for Social Inventions. Kothari is also a Fellow of Ashoka: Innovator for the Public, a non-profit organization based in Washington, D.C., that recognizes leadership qualities in making a difference to society.

About his experience at Cornell, Kothari says, "I learned about the power of the media for social change and also research skills to assess the impact of media. During my doctoral studies I had my first taste of field-work in villages and understood more deeply the core place of literacy in overall human development."

Today, Kothari has moved to other projects to improve reading, especially among children. He is CEO of BookBox, Inc., which creates children's books in digital media to be aired on TV. It is available in 18 languages. While the visuals remain the same, a narrator tells the story in the local language. "The whole idea is that children around the world can have a good variety of stories. A Brazilian story can be told in Hindi, for example, and vice versa."

Kothari has more plans brewing. One is a project drawing on the rich reservoir of Indian folk songs to spread the message of literacy through translation and trans-creation. These songs will be available as downloads on the Internet, he says. "We plan to create a vast digital library of children's books for TV and digital media in all the world's major languages. We'll sell these books in markets that can afford them and put them on TV in markets where individuals cannot buy these products but do watch TV. That way we are able to create a reading experience for all." □

**About the Author:** *Ranjita Biswas is a Calcutta-based freelancer who also translates literature and writes fiction.*



JAYDEEP BHATT, courtesy Same Language Subtitling

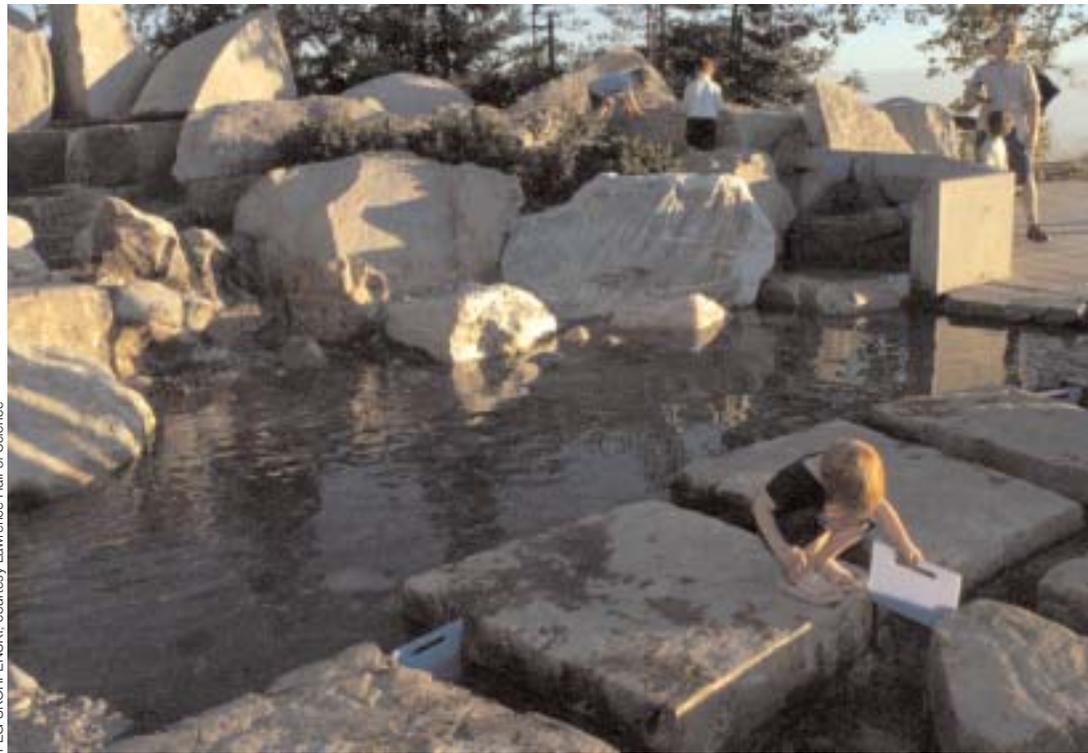


*This giant DNA double helix and the life-sized whale behind it are interactive sculptures meant to be climbed upon by visitors in the Lawrence Hall of Science entrance plaza.*

*By controlling the flow of the central "Sierra Nevada" waterfall in "The Forces that Shape the Bay" exhibit, children learn how water flows.*

paper to fold or cut up, ask students to translate a fractions problem into colored pen drawings, engage the class in cooperative games or use blocks and beans to demonstrate algebra problems. And she will probably invite her students' families to join in the fun. The use of objects, space and movement helps students visualize and understand mathematics, even the most abstract concepts. A program called Family Math is fundamental to the EQUALS approach.

To Franco, used to working with disadvantaged kids, especially those of Hispanic migrant workers, Family Math was a way to get help from the community. It also gave parents tools to help their kids. "I thought if I could get parents to help me out in different ways, we might be able to reach more of the kids, have more success with the kids, not just in mathematics," Franco says. Studies such as that by Robert Leitman, Katherine Binns and Akhil Unni (NACME Research Letter, June 1995) reveal that lack of parental involvement in determining the direction of their children's math program contributes to poor results for the kids. For instance, 93 percent of parents surveyed said they were not informed about the decisions their children must make about future

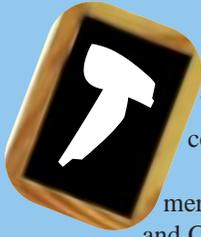


PEG SKORPENSKI, courtesy Lawrence Hall of Science

math courses and the implications of these decisions. Consequently, the students make uninformed decisions. Many plan to drop math and science as soon as they can. They hold misconceptions that a special talent is necessary to do mathematics. Family Math outreach tries to make parents advocates for their children by giving them enough informa-

tion so they can help their children in decision-making. The textbook *Family Math for the Middle School Years* has a chapter with the catchy head, "Dropping Math? Say Goodbye to 81 Jobs." Parents and children are shown the importance of math as a prerequisite for entrance into university and diverse careers—and a steady, respectable income later. They

# YES PROGRAM



Thirty-five high school students have been chosen from India for the first time as part of a Youth Exchange and Study (YES) program to visit the United States to foster better understanding between the peoples of both countries.

The Indian students are among 675 selected worldwide after an open, merit-based process by the U.S. State Department's Bureau of Educational and Cultural Affairs.

As in the past two years, the students selected for the YES program—which is administered by the American Field Service—will attend American high schools, stay with a host family, join social and cultural activities, develop leadership skills and tell Americans about life in India. They will also get to tour the Capitol and the White House to learn about the workings of the federal government.

"There are already some 80,000 Indian students studying in the U.S.," said American Embassy Deputy Chief of Mission Robert O. Blake while honoring the students from New Delhi, Pune and Ahmedabad. "You are the pioneers" of the YES program, he said.

"People-to-people contact," Blake later told journalists, "provides the perfect platform for the relationship between two countries. They are all so excited and happy and will surely become goodwill ambassadors for this country."

YES students go through a three-tiered selection process: written application, interview and final screening by a national selection committee.

Such programs are part of an effort to reach out to a younger, wider population, said Assistant Secretary of State for Educational and Cultural Affairs Patricia S. Harrison. The program "helps these young people discover an America beyond the myths and misconceptions and the headlines." □



VIKAS NARULA

*Left: The first batch of Indian students selected for the YES program interacting with U.S. Deputy Chief of Mission Robert O. Blake.*

*Below: Students find the cities they will visit.*



HEMANT BHATNAGAR

learn that everyone can succeed at mathematics with the right approach.

At a 10-day training workshop in San Leandro, California, a group of teachers are given the core concepts and led through the cooperative exercises they will use with their students. In order to give everyone a chance, classes are organized into six groups with varied responsibilities, which are rotated. The shy and the outgoing alike have the opportunity to develop different organizational skills. "Confidence building" and "equity in classes" are among the important goals, says Grace Davila Coates, Family Math director. During the session, teachers grouped at tables share their problem-solving methods, raise questions and bend their minds to new ways of seeing numbers. "It's not enough for teachers to know content. They must be good crafters of lessons," says Coates. At the break, special education teacher Claudia Stafinski declared, "This is the best thing that has happened to me at this time in my life. It's making me become flexible, to solve other problems besides math."

The teachers will take their tools back to the classroom, but Family Math sessions may take place anywhere. Sessions may be led by a teacher, a parent or interested community member; they might be held in the school library after class, or at a venue like the Kids Breakfast Club, where Franco and his team were asked to present math programs. This twice-monthly meeting informed kids and parents about community resources, health and nutrition. "We worked with parents, talked to them about why it was important for kids to know mathematics." He notes that many adults didn't have a good experience with math in school.

The resulting negative attitude can be detrimental to their children if they give the message that math isn't important, or that they don't really need anything beyond basic arithmetic. Surprisingly, Franco says, "The parents were very interested in being there to learn more mathematics. They were very interested in helping their kids learn." Some parents who never earned their college degree wanted to go back to school. "It's one of

those heartwarming stories that we really like to hear,” he says.

Taking EQUALS programs to where they are needed most—the inner cities and other places where families have social and economic hurdles to overcome—is one of the great challenges. Poverty, fragmented families and crime, coupled with generations of bad school experiences, take a toll on the children, making them hard to reach. “We tell people who are working with these families they have to think out of the box,” Franco says. “We tell our trainers or site directors that they don’t have to do the work at a school site. They should be going to the places where the families congregate....They should be hooking up with the churches, community centers, libraries or science museums.”

Children who might otherwise fail respond well to learning the principles through movement and experience, instead of traditional memorization and working out abstract concepts on paper, he says. Games and puzzles that involve physical activity allow children to absorb the spatial component of math, so that it makes more sense in a real, practical way. EQUALS and Family Math Coordinator Karen Mayfield-Ingram says that for girls, particularly, this is critical. “One of the things that they found in recent research was that there was a difference in gender with regard to spatial reasoning, that there was a difference in the ability to look at things and move them around in space.”

She says giving girls more experience with spatial reasoning at an earlier age will help them with mathematics. The difference stems from the way boys and girls are socialized. Boys tend to get toys that expand their spatial awareness: “They

Children who might otherwise fail can learn through experience instead of memorization.



*Boys examine and experiment with bones at the Bestly Botanicals summer camp at the Lawrence Hall of Science. Kids learn about forest and desert habitats, how animals adapt to harsh climates, observe useful and interesting plant species and try to identify the animal that left its tracks, gnaw marks, scat or bones behind.*

are building, breaking things apart, Legos, construction, Tinker Toys. Girls have things, traditionally in society, that reinforce their language skills, playing with dolls, writing, music and drama.”

Spatial reasoning and mathematical thinking are learned from an early age, Mayfield-Ingram says. “If you wait until the college level, you’ve got a lot to catch up.” Which is why gender parity at the graduate level remains a goal rather than an achievement in most U.S. universities. “The earlier you start with expectations, or the same expectations, with regard to what girls can do mathematically and in science, the better,” she says.

Besides implicit conditioning, or messages that “maybe a child should try something else,” adolescence brings

emotional and peer pressure into it, she says. “Sometimes you get into girls not wanting to appear smart,” thinking they will be less popular or attractive to boys. “Math anxiety is widespread in society,” she says. Changing perceptions about math is no small task.

The latest outreach project, a linkup with local science, math and Spanish language media, has Franco and others at the Lawrence Hall of Science excited. “We will be writing up our activities and dropping them into Spanish language newspapers.” California’s Hispanic population is now a majority in the state. They read their community newspapers. “We are a resource for the community. It’s just another way we are trying to reach the families. We hope that once we get the project rolling we’ll be able to bring on radio and TV.” The program will begin in the San Francisco area, in Houston, Texas, and in Miami, Florida, where EQUALS has linked up with newspapers and science centers. There is potential for doing this in other languages. It is a question of dollars. Franco smiles, “We

# Teaching English

## in South Asia

An Interview with RICHARD BOYUM by LAURINDA KEYS LONG

*Although English is widely spoken in India, it is still a foreign language to many in this and neighboring countries. The U.S. Embassy Office of Public Affairs has appointed Richard Boyum in the new position of Regional English Language Officer (RELO) to share techniques and ideas on different ways to teach English and better prepare South Asia's youth for higher education and employment. Boyum came to New Delhi from Bangkok, where he received an award from the King of Thailand last year for his contributions to education as the RELO in that country. He has a master's degree from Georgetown University in teaching English as a foreign language and bilingual education, and a certificate in distance education from Texas A&M University. He has been a classroom teacher, trainer and program administrator in Africa, the Middle East, South America and Europe. Boyum gave details on his work.*



### What is a Regional English Language Officer?

**RICHARD BOYUM:** A RELO is a State Department Foreign Service Officer specialized in the teaching of English as a foreign language. Our division is part of the Bureau of Educational and Cultural Affairs and located in the Office of Academic Programs. As RELOs, we promote and support the teaching of English and the training of English teachers in our region. For example, we might work with a ministry of education to offer training courses for English teachers, or coordinate with a university on teacher training curriculum development. We also place visiting American professors at selected universities, or identify Indian English teaching professionals to go on training programs to the United States.

### What are the countries in your region?

I cover India, Pakistan, Afghanistan, Sri Lanka, Bangladesh and Nepal.

### Why is the U.S. Embassy opening up a RELO office now?

English is a critical life skill for students in South Asia. The State Department is responding to requests for developing English language teaching expertise in the various countries.

### Most people consider India an English-speaking country. Why is there a RELO assigned to India?

India has a particularly interesting linguistic history. English has played a central role, obviously. Many Indians are virtually native speakers of English, having attended bilingual or English-medium schools. However, in many schools

are going to see how far we can stretch this dollar." He adds, "We are also going to put these activities on the Web so that anyone who has a computer can download them and start doing them at home." That means anyone, anywhere. If a Spanish language newspaper wants to develop an education section, EQUALS will provide the materials online. Franco says, "They can download it, plop it into their newspaper and start running with it. We are also going to try to provide instructions on how to start up the program in your community. We want to extend it beyond the communities we are working with directly." The program will get underway in the next few months. The original intent was to work with multi-ethnic media, so if the Spanish language pilot project is successful, Franco hopes to expand to other languages.



*The "Prove It!" exhibit teaches young detectives how to discover hidden facts using forensic scientific techniques at the Lawrence Hall of Science.*

Besides teaching math, the EQUALS program instills the idea of equity among teachers, addressing the biases that hinder learning.



Courtesy RICHARD BOYUM

*Richard Boyum receives an award from the King of Thailand in November 2004 for his contributions to Thai education through distance learning.*

Fellow program, which places an American professor specialized in English language training at a university to work with future teachers of English. We will have four EL Fellows in India this year, two in Bangladesh and one in Sri Lanka. Another program is the English ACCESS program that offers scholarships to underprivileged youth to pursue extracurricular English language study, to better prepare them for the post-secondary school world of employment or university entrance exams. We also offer teacher training via distance learning. In Thailand we worked with the University of Oregon to offer a monthly series of training programs via satellite for teachers of English all over the country. In Egypt we got English classes to link via the Internet with classes in other countries and engage in a variety of projects using English as the common language.

**What are your objectives for your work in India?**

Well, I'd first of all like to get acquainted with the English teaching environment in all its different forms here, and then bring some of our resources to contribute to English language teaching and training as desired or requested.

**Can you tell a bit about your background and where you have lived overseas?**

Like many Foreign Service Officers I have a "checkered" career. My first experience abroad was as a Peace Corps volunteer in Senegal. Later, after I got my MA, I worked in Saudi Arabia. When I joined the State Department I got assigned to Egypt, Brazil, Thailand and now India. □

throughout the country, initial instruction is in the native language and Hindi. Then later, English is offered for a few periods a week as a subject. So in those situations, with limited contact with the language, familiarization with the methods and materials used in modern foreign language teaching may be useful. Under those circumstances for language learning, it may also be useful to share what we have learned about teacher preparation for the English as a second language environment we have in so many communities in the United States.

**Can you give some examples of the kind of work you've done in other countries?**

One of our most useful resources is the English Language

That would fit well with the international network of EQUALS sites, which are often based in schools or universities, but are not limited to institutions. "We are trying to reach the community at large with whatever tool we can. I think that would be the advice I would give anybody." Be creative, he says, "The school is not necessarily the only place you should hook up with. Other members of our community are involved in education and they can contribute."

Besides teaching mathematics, instilling equity is part of the EQUALS mission. Franco says, "We try to address the biases that we all have toward groups of people, for whatever reason. The first thing that comes to mind is the color of our skin, but that's not the only bias we have. There are so many biases out there." Awareness of

this is critical to teach effectively. "If you have a bias toward a student, that can easily influence the expectations that you have of that student and your interactions with that student." He admits, "Equity is not an easy issue to talk about. In fact, if you are doing equity work and everyone is on the same page and everybody says, 'Oh, everything is fine,' you are not doing something right. When you are doing equity work there is going to be a certain level of discomfort." Dealing with it brings change. Especially with children from minority language groups. "We have to raise our expectations of what they can or cannot do."

Franco is a crusader in a world where too many teachers still cling to the old ways. The statistics on kids who go on to advanced math are not encouraging.

"Teachers have to step back and look at how they teach mathematics," he says. "One way doesn't necessarily work for every child. There are so many learning styles. To do the same thing the same way year in and year out with all these different groups of kids just isn't going to work. It's not going to reach all these kids."

Manipulating a bunch of toothpicks or paper squares, combining them to see how numbers relate to each other, is an easy way to make palatable what has long been bitter medicine to lagging math students. Math should be fun, Franco says. "I'm a firm believer that everyone can learn. We just need to find the way to reach every student." □

**About the Author:** *Lea Terhune is a freelance writer based in California and a former editor of SPAN.*